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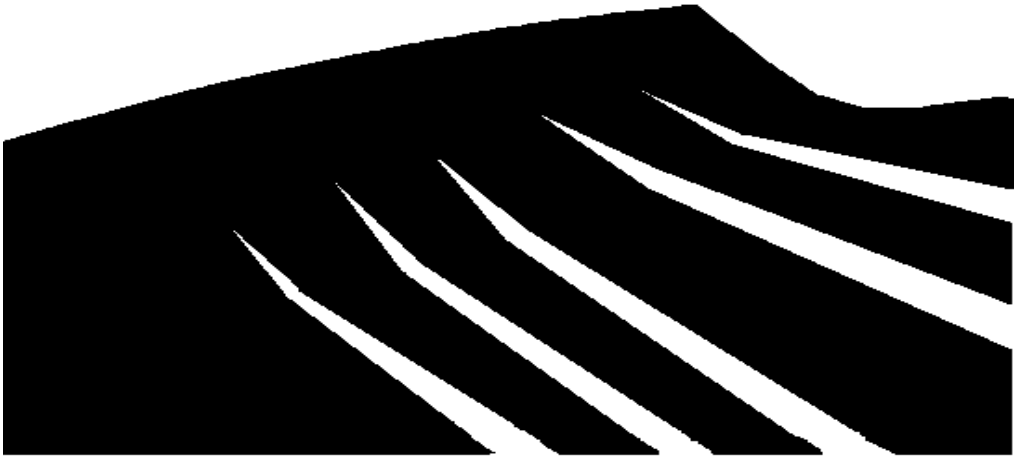
BOREHOLE WIRELINE MEASUREMENTS

LOS ALAMOS
QUALITY PROGRAM



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Los Alamos
Yucca Mountain Site Characterization Project

HISTORY OF REVISION

REVISION NO.	EFFECTIVE DATE	PAGES REVISED	REASON FOR CHANGE
R0	01/09/97	N/A	Initial procedure.

BOREHOLE WIRELINE MEASUREMENTS

1.0 PURPOSE

This Detailed Technical Procedure (DP) describes the operational process for collecting geophysical wireline measurements from boreholes for the Yucca Mountain Site Characterization Project. This procedure applies to the acquisition of geophysical wireline data that may include a Borehole Camera, Caliper, Gamma, Density, and Neutron tools.

2.0 SCOPE

This procedure applies to Los Alamos Test Coordination Office (TCO) personnel, working under the Office of Civilian Radioactive Waste management quality assurance program, who collect wireline measurements in boreholes.

3.0 REFERENCES

LANL-YMP-QP-02.7, Personnel Training
LANL-YMP-QP-03.5, Documenting Scientific Investigations
LANL-YMP-QP-12.3, Control of Measuring and Test Equipment and Standards
LANL-YMP-QP-17.6, Records Management
YMP Radiological Control Manual
OCRWM M&O Radiation Protection Plan

4.0 DEFINITIONS

Caliper Rings - A piece of pipe used to calibrate the caliper tool in the field.

Stick Up - The portion of push rods extending out of a borehole past the zero datum point.

Total Depth Reached - The deepest point in a borehole reached by a tool. This is not necessarily the total depth of the borehole.

Zero Datum Point - A point established at the start point for depth measurements.

5.0 RESPONSIBILITES

The following personnel are responsible for the activities identified in Section 6.0 of this procedure:

- TCO Staff and their Designees

6.0 PROCEDURE

The use of this procedure must be controlled as follows:

- If this procedure cannot be implemented as written, employees should notify appropriate supervision. If it is determined that a portion of the work cannot be accomplished as described in this DP, or would result in an undesirable situation, that portion of the work will be stopped and not resumed until this procedure is modified, replaced by a new document or the current work practice is documented in accordance with QP-03.5, section 6.1.6.

- Employees may use copies of this procedure printed from the controlled document electronic file; however, employees are responsible for assuring that the correct revision of this procedure is used.

- When this procedure becomes obsolete or superseded, it must be destroyed or marked “superseded” to ensure that this document is not used to perform work.

6.1 Principle

Principle investigators and other project personnel from various affected organizations may require the use of information obtained from boreholes. This DP provides for the collection of qualified acquired data from boreholes that will in turn be submitted to the technical data base and/or records systems. It is the responsibility of individuals using this acquired data to perform any data reduction or development.

6.2 Equipment and Hardware/Software

The following equipment is used, but is not limited to, in the implementation of this procedure:

- Borehole video camera system
- Cable/winch system
- Computer
- Gamma tool
- Neutron tool
- Commercially available tape measure (metric or English)
- TV/VCR
- Push rods
- Caliper tool
- Density tool
- Radioactive sources
- Calibration equipment
- Digital readout unit (DRU)

The following commercially available software is used in the implementation of this procedure:

- AUSLOG Digital Logging System (DLS)

6.2.1 Equipment Malfunctions

Malfunctions of a significant nature associated with each system or tool will be apparent to the operator.

6.2.2 Safety Considerations

Before working in construction areas, **TCO staff** or their designees will survey the work area to identify potential hazards such as moving equipment, electrical hazards, and tripping/falling hazards. Underground operations shall be conducted within the general underground training (GUT) guidelines under the constructor's supervision and safety responsibilities. Safety concerns will be discussed at the beginning of each shift during the constructor "Tool Box" meeting. TCO staff or their designees who use radioactive sources must complete Radiological Worker 1 training.

Operations involving use of a radioactive source will be conducted within the guidelines of the Radiation Protection Plan. This may include designating a temporary radiation area, including the posting of a radiation work permit (RWP) and radiation area signs as required. Each member of the TCO staff or their designees who use radioactive sources or who enters the radiation area are required to wear the appropriate dosimetry, this may include but is not limited to a TLD, neutron, and finger tip dosimetry. Radiological safety concerns are to be brought to the attention of the M&O Radiological Control Manager and the TCO Safety Representative.

6.2.3 Special Handling

Use of a radioactive source will be conducted within the guidelines of the Radiation Protection Plan. Although this equipment is designed for field use, care should be taken to minimize rough handling. Impacts to this equipment could cause damage to sensitive internal parts.

6.3 Preparatory Verification

Before conducting work, the **TCO staff** or designees performs a visual inspection of equipment, making any necessary corrections.

6.3.1 Hold Points

N/A

6.3.2 Calibration

The following equipment is calibrated as indicated in section 6.5 and is documented according to QP-12.3:

- An electronic depth device
- A caliper tool
- A gamma ray tool
- A density tool
- A neutron tool

6.3.3 Environmental Conditions

Logging tools may not work above 140°F.

6.4 Control of Samples

N / A

6.5 Implementing Procedure

6.5.1 General

TCO staff or their designees applies the following to each type of logging service used.

6.5.1.1 Ensure work environment is safe and necessary equipment is available and functional.

6.5.1.2 When applicable, ensure M&TE is calibrated as described in the sections below.

6.5.1.3 Identify the borehole with its unique borehole number.

6.5.1.4 Establish the location of a zero datum point.

6.5.1.5 Depth measurement shall be obtained by one of the following methods:

a) Attaching tape measure to the tool, or

b) Calculating depth by summing the total length of push rods used, plus tool length, minus stick up, or

c) Measure the length of the tool and cable inserted into the borehole using a tape measure, or

d) Calibrated measurement device for tool.

NOTE: Unless M&TE is specified in the remaining steps in section 6.5 references to determining depth refers to the methods used in subsections 6.5.1.5a, 6.5.1.5b, or 6.5.1.5c.

6.5.1.6 Provide tracibility between notebook entries and related video tapes / data files.

6.5.2 **TCO staff** or their designees calibrates the Auslog electronic depth counter as follows:

6.5.2.1 Thread the cable head and cable through collar-measuring wheel assembly.

6.5.2.2 Attach the cable head to tool.

6.5.2.3 Measure the length of logging tool assembly including cable head.

6.5.2.4 Insert the logging tool into borehole.

6.5.2.5 Position the collar-measuring wheel assembly in borehole.

6.5.2.6 Position the logging tool in borehole to start in-run.

6.5.2.7 Determine if the in-run and / or the out-run is to be used for the logging run.

6.5.2.8 Determine the correction factor for either run by comparing the in-run and / or out-run measured depth with that of the electronic depth counter for the specific run as follows:

a) Measure the depth of the tool at the start of the in-run, set the electronic depth counter to the start depth, measure the depth of the tool at the total depth reached, and note the depth of the electronic depth counter,

or

b) Measure the depth of the tool at the total depth reached, set the electronic depth counter to this depth, measure the depth at the end of the out-run, and note the depth of the electronic depth counter.

6.5.2.9 Record the difference between measured depth and that of the electronic depth counter.

6.5.3 **TCO staff** or their designees conducts video taping operations as follows:

6.5.3.1 Configure the TV.VCR to record.

6.5.3.2 Insert a camera into the borehole and conduct the run, pausing the camera as needed.

6.5.3.3 View the video tape to ensure it is legible and adequate for its intended purpose.

6.5.3.4 Repeat the process if the video information is inadequate and identify any unusable entries / video runs as inadequate.

6.5.3.5 Record the borehole identifier, date, M&TE serial numbers if applicable, the location of the zero datum point, traceability between the notebook and the video, depth correction measurements if applicable, and total depth reached in the scientific notebook.

6.5.4 **TCO staff** or their designees conducts Auslog Caliper Tool operation as follows:

6.5.4.1 Attach the caliper tool to the end of the cable and configure for a caliper survey.

6.5.4.2 Determine the diameter of the caliper rings by using a tape measure

6.5.4.3 Perform a before log of the two caliper rings. If there is deviation between the calibration ring diameter and the recorded trace beyond 0.25 inches, recalibrate the tool.

6.5.4.4 Calibrate the caliper tool when necessary by selecting the F4 key on screen S-201

a) Open caliper arms using the F3 key on screen S-900. Press the F3 key when the arms are fully open. Press F1 to continue.

b) Check that the sizes of calibrating rings used correspond with the size of the rings available on screen S-335.

c) Place the smaller ring over the arms as requested then press F1 to take a reading.

d) Place the larger ring over the arms as requested then press F1 to take a reading.

6.5.4.5 Close tool at this time (prior to inserting into the borehole).

6.5.4.6 Insert the caliper tool into the borehole and continue to total depth. Use depth procedure as outlined in 6.5.2.

6.5.4.7 Open tool when total depth is reached.

6.5.4.8 With the program in record mode perform logging run.

NOTE: A speed of six to 12 meters per minute typically gives the best results.

6.5.4.9 Perform an after log of the two caliper rings to show the tool response. The recorded trace should be within 0.25 inches of the calibration rings.

6.5.4.10 Close tool and rig down.

6.5.4.11 Record the borehole identifier, date, M&TE serial numbers, the location of the zero datum point, file names (for pre-and post calibration runs as well as the actual run), AUSLOG software version number, traceability between the notebook and the data files, depth correction measurements, and total depth reached in the scientific notebook.

6.5.5 **TCO staff** or their designees conducts Auslog Gamma Ray tool operation as follows:

6.5.5.1 Attach the Gamma Ray tool to the end of the cable and configure for a gamma ray survey.

6.5.5.2 Set the Nuclear/Electric switch to the Nuclear position.

6.5.5.3 Select the logging function.

6.5.5.4 Perform a before log of the gamma ray background response.

6.5.5.5 Insert the gamma ray tool into the borehole and continue to total depth. Use depth procedure as outlined in 6.5.2.

6.5.5.6 With the program in record mode pull the tool out of the hole at as constant a rate as practical.

6.5.5.7 Perform an after log of the gamma ray background response.

6.5.5.8 Record the borehole identifier, date, M&TE serial numbers, the location of the zero datum point, file names (for pre-and post calibration runs as well as the actual run). AUSLOG software version number, traceability between the notebook and the data files, depth correction measurements, and total depth reached in the scientific notebook.

6.5.6 **TCO staff** or their designees conducts Auslog neutron tool operation as follows:

6.5.6.1 Designate a temporary radiation area following step 6.2.2.

6.5.6.2 Set the winch, recorder, and supporting equipment in the operating position making sure all interconnecting cables are in place and the Nuclear-Electric switch in the Nuclear position.

6.5.6.3 Selecting Neutron Tool from the Tool Selection Menu.

6.5.6.4 Perform before survey tool response check following the procedure as directed on the computer screen. To be statistically valid, 68.3% of the count rates during the tool response check should be within one standard deviation of the average count rate during the response check, and 95.5% of the count rates should be within two standard deviations.

6.5.6.5 Turn tool off and disconnect from the cable head.

6.5.6.6 Remove the lock from the neutron source storage container and remove the container plug.

6.5.6.7 Screw the Neutron tool tightly onto the source holder in the source container. Double check it.

6.5.6.8 Remove the locking pin.

6.5.6.9 Quickly but calmly attach the neutron tool to the end of the cable and place it in the borehole and continue to total depth. Use depth procedure as outlined in 6.5.2.

6.5.6.10 With the program in record mode pull the tool out of the hole at as constant a rate as practical.

6.5.6.11 Perform after survey tool response check following 6.5.6.4.

6.5.6.12 Quickly but calmly disconnect the neutron tool to the end of the cable and place it back in the storage container. Replace the locking pin.

6.5.6.13 Record the borehole identifier, date, M&TE serial numbers, the location of the zero datum point, file names (for pre-and post calibration runs as well as the actual run), AUSLOG software version number, traceability between the notebook and the data files, depth correction measurements, and total depth reached in the scientific notebook.

6.5.7 **TCO staff** or their designees conducts CPN neutron tool operation as follows:

6.5.7.1 Designate a temporary radiation area following step 6.2.2.

6.5.7.2 Configure system for neutron operation connecting the tool cable to the digital readout unit (DRU).

6.5.7.3 Remove the neutron tool from its storage container and perform before survey tool response check. The M Chi value produced by the DRU as a result of the test should be between 0.8 and 1.2. If not, trouble shoot the equipment and repeat the test as required.

6.5.7.4 Place the neutron tool in the borehole, and continue to depth desired. Use depth procedure as outlined in 6.5.2.

6.5.7.5 Record data.

6.5.7.6 Perform after survey tool response check following step 6.5.7.3

6.5.7.7 Replace the neutron tool back in its storage container.

6.5.7.8 Record the borehole identifier, date, M&TE serial numbers, the location of the zero datum point, the data values, depth correction measurements, and total depth reached in the scientific notebook.

6.5.8 **TCO staff** or their designees conducts CPN Density Tool operation as follows:

6.5.8.1 Designate a temporary radiation area, following step 6.2.2.

6.5.8.2 Configure system for density operation connecting the tool cable to the DRU.

6.5.8.3 Remove the density tool from its storage container and perform before survey tool response check. The M Chi value produced by the DUR as a result of the test should be between 0.8 and 1.2. If not, trouble shoot the equipment and repeat the test as required.

6.5.8.4 Place the density tool in the borehole, and continue to depth desired. Use depth procedure as outlined in 6.5.2.

6.5.8.5 Record data.

6.5.8.6 Perform after survey tool response check following step 6.5.8.3.

6.5.8.7. Replace the density tool back in its storage container.

6.5.8.8 Record the borehole identifier, date, M&TE serial numbers, the location of the zero datum point, the data values, depth correction measurements, and total depth reached in the scientific notebook.

6.6 Data Acquisition and Reduction

Data is acquired as described in section 6.5 and is considered acquired (raw) data. Parameters to be recorded may include but are not limited to, borehole depth, borehole diameter, and borehole geologic description. Further data reduction, development, or analysis is the responsibility of the affected organization using the data.

6.7 Potential Sources of Error and Uncertainty

N / A

7.0 RECORDS

Records generated as a result of this DP are entries in laboratory notebooks or attachments to laboratory notebooks. The documentation should consist of any applicable items identified in Section 6.0 of this procedure. Laboratory notebooks should be kept in accordance with QP-03.5.

All records should be submitted to the Records Processing Center in accordance with QP-17.6.

8.0 ACCEPTANCE CRITERIA

Data runs are considered acceptable if they are legible, met the requirements of this procedure, and are determined by TCO Staff to be acceptable for their intended use based on the needs of the PI organizations. In addition, depth measurements using M&TE must be within 1 meter per 100 meters without the application of correction factors. Any unacceptable borehole runs may be re-run. Data from unacceptable runs need not be recorded.

9.0 TRAINING REQUIREMENTS

9.1 Prior to conducting work described in Section 6.0, the user requires training to this procedure. Training to this procedure is accomplished by “read only”.

9.2 TCO staff handling radioactive sources must complete Radiological Worker I training as provided by the Department of Energy.

9.3 Training will be documented per QP-02.7.

10.0 ATTACHMENTS

N / A